RESPONSE TO CYCLIC SELECTION FOR SEED YIELD AND OIL CONTENT IN SUNFLOWER POPULATION - ARMAVIRISKI 3497

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Abstract

The population improvement following Pustovoit model was adopted in an open pollinated variety of sunflower Armaviriski 3497. The response to selections for seed yield and oil content was assessed through five cycles. The seed oil content responded positively while there was no significant response for seed yield. At the end of fifth cycle, the mean seed oil content increased from 41.4 per cent in base population to 46.9 per cent. The population after five cycles of selection still showed large variability for oil content suggesting the possibility of realising positive selection response in the subsequent cycles. Such selection procedure based on Pustovoit model is an effective method in genetic upgradation of sunflower populations.

Introduction

In Asia, India is one of the major sunflower growing countries with an area of about 0.7 million hectares during 1983-84. About a decade back, the crop was grown over a few thousand hectares and the present spectacular increase is mainly attributed to the varietal renovation and seed production of open pollinated varieties initiated during the year 1977. Sunflower breeders in the U.S.S.R. successfully employed this procedure of varietal renovation based on Pustovoit scheme ("method of reserves") in raising the oil content of sunflower cultivars from about 30% to over 50%. In the present investigation, an attempt has been made to assess the improvement in seed yield and oil content of open pollinated variety Armaviriski 3497 (EC.68415) in response to five cycles of selection for these two traits.

Materials and Methods

EC.68415 is the recommended open pollinated variety for commercial cultivation in Karnataka State and it formed the base material for initiating cyclic selection during summer 1977. Data on total number of selections made, the range, mean and standard deviation for seed yield and oil content in each cyclic generations (C) are presented in Table 1. The selected lines which surpassed the mean values for both seed yield and oil content were advanced for progeny evaluation.

Based on the progeny performance, the remnant seeds of elite plants were bulked to raise the panmictic population. The bulk seed derived from panmictic population formed the base material for second cycle of selection. This procedure was followed in all the cyclic generations. Phenotypic selection at the time of harvest was based on uniformity in maturity and plant height. Oil content on whole seed basis was analysed using Bruker Minispec 20 Pi NMR-Spectrometer.

Results

In the base population (C_0), the mean values for seed yield and oil content were 72.5 gm and 41.4% respectively for 3,216 individual plant selections made in the open pollinated variety EC.68415 (Table 1). The standard deviation value for seed yield was highest and it showed decreasing trend in subsequent cycles of selection except C_5. Improvement in mean seed yield per plant was observed only in C_1 and in subsequent cycles the values recorded were lower than the value recorded in C_0. In contrast, the response for oil content was in positive direction. The first cyclic selection (C_1) resulted in steep increase in the oil content (45.6%). There was decline in oil content in C_2 but in later generations (C_3 to C_5) increasing trend for oil content was observed. At the end of C_5 generation, the mean oil content was 46.9 recording an increase of 13.3% over C_0.

Discussion

In India, commercial cultivation of sunflower commenced about a decade back with open pollinated varieties received from U.S.S.R. In early seventies, the farmers did not evince keen interest in sunflower cultivation as decline in seed yield and oil content was encountered due to the absence of any programme on varietal renovation and quality seed production (Seetharam, 1981; Giriraj, 1983). In order to impart yield stability and upgrade oil content in EC.68415, varietal renovation based on "method of reserves" was initiated. The results obtained over five cyclic selections showed negative response for seed yield. The original population of Armaviriski 3497 introduced from U.S.S.R. was highly self-incompatible and due to inadequacy of pollinating agents in areas where sunflower cultivation commenced, there was a serious problem of achene chaffyness resulting in very poor seed yields. This might have happened even in the experimental fields where cyclic selections was practiced. This has indirectly increased self fertility of the population but resulted in genetic drift and inbreeding depression in the later cycles. This is attributed as one of the reasons for the gradual reduction in mean plant yield from C_2 to C_4 and yield stabilizing at a certain level from fifth cycle. Harinarayana et al. (1980) practiced three cycles of selection in three genetically diverse populations of sunflower and reported gain in seed yield only in one population. They concluded seed yield as a complex variable influenced by environmental factors.

In contrast, oil content showed positive response for cyclic selections. The per cent increase over C_0 ranged from 8.2 per cent in C_2 to 13.3 per cent in C_5, which is substantial. The results are in conformity with Harinarayana et al. (1980).

Oil content is a stable character as compared to seed yield. According to Fick (1975), oil content is a highly heritable trait. Taking this into consideration and also variability still existing in the population even at the end of five cyclic selections, subsequent selection for oil content would be quite effective in realising higher oil yield. The sunflower breeders in U.S.S.R. have already established the importance of "method of reserves" in upgrading oil content in sunflower cultivars. However, there is a limitation to this procedure. The response to selection will not be effective when the oil content based on the whole seed reaches 60 per cent. But it may be said that although heterosis breeding has resulted in realising higher seed yield, the heterotic effect for oil content is not of higher magnitude. The character being mainly under additive control, there is little scope for exploitation of heterosis for oil content. The development of inbred lines with high oil content for use in heterosis breeding should be derived from populations which have passed through cyclic selections in population improvement programmes. Hence, whether it is for heterosis breeding or for population improvement, the "method of resesves" is a starting step in sunflower breeding programmes. This method is of particular relevance to countries where the crop is recently introduced and heterosis breeding is in initial stage of development.

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Table 1. Data on range, mean, standard deviation and selection response for seed yield and oil content in sunflower population Armaviriski 3497

Generation	Total single plant sele-ction	Seed yield				Oil content			
		Range(g)	Mean(g)	S.D.	% increase or decrease over base population	Range(%)	Mean(%)	S.D.	% increase over base popula-tion
Base population									
C_0	3,216	22.8-146.6	72.5	22.57	-	31.3-52.8	41.4	3.56	-
C_1	2,066	20.0-133.0	80.0	20.72	+10.3	29.3-54.8	45.6	4.03	+10.1
C_2	2,230	21.3-127.6	56.7	17.00	-21.8	26.1-55.2	44.0	5.22	+ 8.2
C_3	1,253	24.0-126.0	58.0	16.69	-19.3	31.3-54.9	45.6	5.48	+10.1
C_4	2,610	23.5-133.0	56.0	16.49	-22.8	26.5-55.2	45.8	3.88	+10.6
C_5	2,208	24.3-142.0	67.4	19.10	- 7.0	31.6-56.6	46.9	4.69	+13.3